

September 1999

Tillamook Bay/Garibaldi Boat Basin Sediment Sampling Evaluation

Abstract

The screening levels (SL) used are those adopted for use in the Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area (November 1998). This evaluation was conducted following procedures set forth in the Inland Testing Manual (ITM) and the Ocean Disposal Testing Manual (Green Book), developed jointly by the Corps and EPA to assess dredged material. Guidelines used are those developed to implement the Clean Water Act (CWA) and the Marine Protection, Research and Sanctuary Act (MPRSA). Oregon Department of Environmental Quality Clean-up Standard in Soil and Water Quality Criteria were referenced for upland sediment placement and monitoring of return water.

Six sediment samples were collected in Tillamook Bay at Garibaldi Boat Basin, September 15, 1998 (see Figure 1). All 6 samples were sent to Sound Analytical Services, Inc. laboratory in Tacoma, WA, for physical analyses and for the following chemical analyses: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, chlorinated organic compounds, miscellaneous extractables, and polynuclear aromatic hydrocarbons (PAH). Samples from 3 stations within the boat basin were composited for tributyltin (TBT).

Median grain size for all samples is 0.07mm, with 54.1% sand and 47.5% fines. The chemical analyses, for all but one contaminate of concern, were below screening levels of the DMEF. The non-carcinogenic PAH, fluoranthene, exceeded the 1700 ug/kg (ppb) screening level with a concentration of 2900 ug/kg level in the TB-BC-05 sample. The sediment represented by this sample would not be suitable for open inwater placement without further characterization. The DEQ cleanup level for fluoranthene in soil is 8,000 mg/kg (ppm). All sediments tested would be suitable for upland placement, with containment and monitoring of return water.

Introduction

The purpose of this report is to characterize the sedimentation deposits with-in the navigational channel and boat basin entrance. Reference will be made to the project Sampling and Analysis Plan (SAP) attached to this report. The project description, site history and assessment are detailed in section 1 of the SAP. The sampling and analysis objectives listed below are those stated in the (SAP) (sec. 2.0). This report will outline the procedures used to accomplish these goals.

SAMPLING AND ANALYSIS OBJECTIVES

The sediment characterization program objectives and constraints are summarized below:

To characterize sediments in accordance with the Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River management Area manual.

Collect, handle and analyze representative sediment, surface and core samples of the proposed dredging prism in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.

Characterize sediments to be dredged for evaluation of environmental impact.

Conduct only physical and chemical characterization, unless further characterization is required prior to dredging.

Historical Data

Sediment samples were collected in December 1980 for elutriate chemical and physical analysis from Tillamook Bay entrance channel and the Garibaldi Boat Basin access channel. Water was collected and chemically analyzed for comparison with the navigation channel elutriates.

In May and July of 1985 sediment was collected from the Garibaldi Boat Basin access channel for physical and chemical analysis. Sediments were considered acceptable for open water disposal.

The most recent sampling event was March 22, 1990, when sediment samples were collected at 6 stations along the part of the channel fronting the Garibaldi Boat Basin. Three core samples collected near the entrance to the boat basin were taken using a gravity core sampler. The other 3 samples were surface grab samples taken with a Ponar sampler. All samples were submitted for physical analysis. Sediments outside the entrance to the boat basin were predominately sandy material with increasing amounts of gravel towards the mouth of the Miami River. Samples from the boat basin entrance channel were fine grained material (fines 50.3% to 71.5%) with volatile solids ranging from 7.3% to 11.6%. Material was similar to material collected in 1980 and 1985. The three core samples were, also, submitted for chemical analyses. The material represented by these samples was determined to be suitable for unconfined in-water placement.

Current Sampling Events

The Army Corps of Engineers, Portland District personnel, collected 3-gravity core samples (TB-GC-01 to 03) and 3 box core samples (TB-BC-04 to 06) on September 15, 1999 (figure 1). The samples were shipped to Sound Analytical laboratory of Tacoma, WA, for physical and chemical analyses; to include metals, total organic carbon (TOC), pesticides/PCBs, phenols, phthalates, chlorinated organic compounds, miscellaneous extractables and polynuclear aromatic hydrocarbons (PAHs). A composite TBT analysis was run on 3 sampling stations. The median grain size for all sediment was 0.07mm, with 54.1% sand and 47.5% fines. One chemical of concern (Fluoranthene) was detected above the established screening level (SL) (1700 ppb) in sample TB-BC-05 (2900 ppb). This was the only PAH in all the samples that exceeded the SL.

The total dredge volume, of approximately 27,000 CY, will be placed upland by pipeline dredge. The intended use of the upland site has not been determined at this time.

Sampling and analyses were performed using proper quality control measures, including proper procedures for chain of custody, preservation (4°C.) and cooler receipt. The laboratory (SAS) QC is acceptable. The lab ran bulk TBT analysis rather than the pore water analysis requested in the lab contract bid.

Results/Discussion

Physical and Total Volatile Solids (TVS): Data for these analyses are presented in Table 1. Five of 6 samples submitted for analyses exceeded 20% fines and 5% volatile solids. Three samples taken from the boat basin were classified as “silt”. Of the 3 samples collected from the outside channel, 2 were classified as “silty sand” and 1 as “poorly graded sand with silt”. Median grain size for all samples is 0.07mm, with 54.1% sand and 47.5% fines. As expected the sediment within the boat basin contains more fine material than the channel leading to the basin.

Metals and Total Organic Carbon (TOC): Data for these analyses are presented in Table 2. Low levels of 8 metals were found in all of the 6 samples analyzed, but do not approach the SL. One sample contained a level of Mercury at 29.2% of the SL. Of the other metals detected the highest was for Nickel, which was 45.7 % of the SL.

Pesticide/PCBs, Phenols, Phthalates, Chlorinated Organic Compounds and Misc. Extractables: Data for these analyses are presented in Table 3. No PCBs or (total) DDT was detected (at the method detection limits) in any of the 6 samples analyzed. Some very low levels of other pesticides, that do not have established SLs, were detected. One phenol was detected at a very low level in all of the samples (<6.3% of the SL). Four phthalates were detected at low levels in 1 or more of the 6 samples (<1.1% of the SL), with the exception of Dimethylphthalate in the TB-GC-02 sample, which contained 92.9% of the SL.

Polynuclear Aromatic Hydrocarbons (PAHs): Data for PAHs are presented in Tables 4 & 5. Low levels of some “low molecular weight” PAHs were found in 5 of 6 samples. The highest level detected was 3.4% of the SL. Low levels of “high molecular weight” PAHs were found in most samples, with the exception of Fluoranthene (2900 ug/kg), which exceeded the 1700 ug/kg SL in the TB-BC-05 sample. Fluoranthene is a non-carcinogenic byproduct of fossil fuel burning and is found in fuel.

Organotin (Tributyltin - TBT) – bulk analysis: Data for TBT are presented in Table 2. TBT in this report was not analyzed using the interstitial (pore) water extraction method of analysis, but rather the bulk TBT analysis used in past studies. (The laboratory (SAS) failed to run the pore water analysis requested in the contract). No TBT was detected in the samples by bulk analysis, with the method detection limit of < 2.0 ug/kg (ppb). The bulk TBT screening level was established at 30 ug/kg (ppb).

Conclusion

Guidelines set forth in section 404 (b)(1) of 40 CFR 230 developed to implement the Clean Water Act (CWA) apply when dredge material is disposed of in either an aquatic or nearshore environment. It also applies when dredge material will be hydraulically placed in an upland environment and effluent from the disposal will be returned to waters of the U.S. Regional guidance derived from this regulation and national guidance manuals has been adopted as the Dredged Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area. The DMEF was developed in cooperation with the regional federal agencies (Corps and EPA) and state agencies (Oregon DEQ, Washington DOE and DNR). The DMEF Tiered testing approach requires that material in excess of 20% fines and greater than 5% volatile solids, as well as any material with prior history or is suspected (“reason to believe”) of being contaminated, be subjected to chemical as well as physical analyses. Under the Tiered approach, if the chemical analytical results do not exceed the established screening levels, the material is cleared for unconfined in-water disposal.

The only contaminate of concern that exceeded the DMEF Screening level (1700 ug/kg) was a high density PAH, fluoranthene, at a 2900 ug/kg concentration, in the TB-BC-05 sample (others were all low level). The TB-BC-05 sample is 78.1% sand 21.9% fines and 7.6 % volatile solids. This sample represents less than a third of the total volume of the 27,000 cy. The average of fluoranthene, represented by the 6 samples collected is 547 ug/kg, well below the DMEF screening level and the DEQ soil cleanup level of 8000 mg/kg. Some mixing will occur in both the sediment that is dredged, as well as the return water, when sediment is hydraulically placed upland, that will level the higher concentration of sediment represented by sample TB-BC-05.

The dredging prism depth, where the TB-BC-05 sample was taken, is approximately 3 feet. The sample collected was a surface, box core sample (gravity core would not penetrate sandy material). The proposed dredging prism has in-filled since the last dredging event in 1990. No PAHs were detected in the 1990 sample analysis. The previously clean dredge site would indicate that the “newly exposed surface” after dredging would be clean.

All sediments tested would be suitable for upland placement, with containment and monitoring of return water to meet the Water Quality Criteria guidelines for fluoranthene (40 ug/L marine acute criteria and 16 ug/L marine chronic criteria).

References

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Physical Analysis

	Grain Size (mm)				%					
Sample I.D.	Median		Mean		Gravel	Sand	Silt/Clay	Volatile solids		
TB-GC-01	0.03		0.14		0.6	26.6	72.8		11.4	
TB-GC-02	0.03		0.07		0.0	39.6	70.4		8.7	
TB-GC-03	0.03		0.06		0.0	27.4	72.6		10.0	
TB-BC-04	0.12		0.11		0.0	93.9	6.1		3.0	
TB-BC-05	0.12		0.07		0.0	78.1	21.9		7.6	
TB-BC-06	0.07		0.05		0.0	59.0	41.0		6.5	
TB-BC-06 lab dup.	0.07		0.05		0.0	57.6	42.4		6.8	
Mean	0.07		0.08		0.1	54.1	47.5		7.9	
Minimum	0.03		0.05		0.0	26.6	6.1		3.0	
Maximum	0.12		0.14		0.6	93.9	72.8		11.4	

Inorganic Metals, TOC and TBT

Sample I.D.	As	Sb	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC	TBT
	mg/kg (ppm)										ug/kg - ppb
TB-GC-01	5.9	<1.0	0.23	70	19	0.12	60	0.45	130	57000	<2.0
TB-GC-02	6.3	<0.76	0.24	44	<13	0.061	47	0.29	90	25000	<2.0
TB-GC-03	5.5	<0.87	0.21	53	<15	<0.069	55	0.28	100	31000	<2.0
TB-BC-04	2.3	<0.06	<0.13	48	<10	<0.044	59	0.25	76	1700	-
TB-BC-05	5.1	<0.71	1.3	54	<12	<0.051	64	0.29	100	20000	-
TB-BC-06	4.6	<0.70	<0.15	45	<12	0.054	54	0.20	90	18000	-
Screening level (SL)	57	150	5.1	390	450	0.41	140	6.1	410		30
Mean	5.0	ND	0.33	52	3.1	0.029	56.5	0.29	97.7		
Maximum	6.3	ND	1.3	70	19	0.12	64	0.45	130		
TBT = Analysis of a composite sample of TB-GC-01, TB-GC-02, TB-GC-03 (Bulk method).											
Symbol (-) = Indicates analysis not run.											
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).											

Pesticides/PCBs, Phenols, Phthalates, Herbicides and Extractables

Sample I.D.	Pesticides					Phenols			Phthalates			
ug/kg (ppb)												
	Alpha-BCH	Bata BCH	Gamma BHC	Hepta chlor	Total DDT		3-&4-Methyl phenol		bis(2-Ethylhexzyl phthalate	Butylbenzyl phthalate	Di-n-butylphthalate	Dimethyl phthalate
TB-GC-01	0.31	<2.2	0.73	<2.2	<4.5		42		54	<2.6	31	4.2
TB-GC-02	<1.8	<1.8	<1.8	<1.8	<3.5		4.9		25	<1.9	54	1300
TB-GC-03	<2.0	<2.0	<2.0	<2.0	<4.1		4.9		46	<2.2	15	<2.5
TB-BC-04	0.9	<1.3	<1.3	<1.3	<2.6		4.4		18	2.9	14	<1.6
TB-BC-05	<1.5	<1.5	<1.5	0.18	<3.0		<1.7		20	<1.6	8.4	<1.8
TB-BC-06	<1.6	0.6	<1.6	0.45	<3.1		2.1		21	12	13	<1.8
Screen level (SL)	*	*	*	*	6.9		670		8300	1200	5100	1400
Mean	0.2	0.1	0.12	0.11	ND		9.7		30.1	2.5	22.6	217.4
Maximum	0.9	0.6	0.73	0.45	ND		42		54	12	54	1300

* = SL has not been established.

PCBs = Non-detect (ND) <27.0 ppb (SL = 130 ppb).

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Polynuclear Aromatic Hydrocarbons (PAHs)

Low Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phenanthrene	Total Low PAHs
TB-GC-01	<3.2	<4.0	11	6.2	<3.8	5	30	52
TB-GC-02	<3.0	4.9	2.7	<3.0	<3.0	4.6	7.3	20
TB-GC-03	<2.8	<3.5	<3.3	<3.4	<2.1	<1.8	4.4	4
TB-BC-04	<1.7	<2.2	<2.0	<2.1	<2.1	<1.8	<1.8	ND
TB-BC-05	4.2	86	66	16	<2.4	<2.1	20	192
TB-BC-06	<2.0	<2.5	4.1	<2.4	<2.3	<2.0	4.1	8
Screen level (SL)	500	560	960	540	670	2100	1500	29000
Mean	0.7	15.2	14.0	3.7	ND	1.6	11.0	
Maximum	4.2	86	66	16	ND	5	30	

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

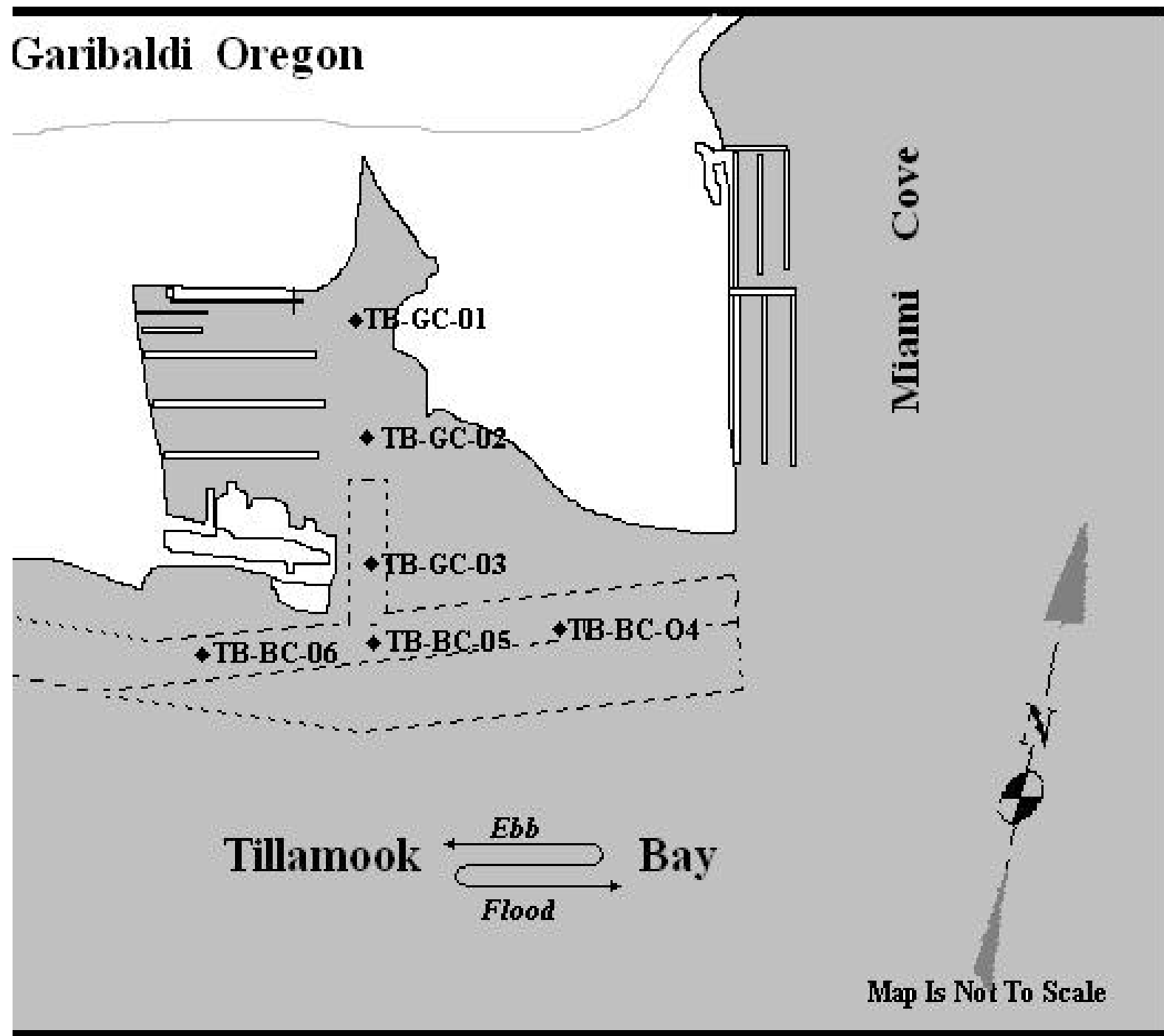
Polynuclear Aromatic Hydrocarbons (PAHs)

High Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Benzo(a) Anthra cene	Benzo(b) fluro anthene	Benzo(k) fluro anthene	Benzo(g,h,i) perylene	Chrysene	Pyrene	Benzo(a) pyrene	Dibenz(a,h) anthracene	Indeno (1,2,3-cd) pyrene	Fluoran thene	Total High PAHs
TB-GC-01	<3.7	<3.6	<3.2	<2.6	100	57	110	<2.4	<3.0	57	324
TB-GC-02	3.0	16	4.3	7.0	18	9.1	9.8	<3.0	3.0	8.5	79
TB-GC-03	4.0	4.0	<1.8	<1.4	4.4	5.1	<1.4	<1.3	<1.6	8.4	26
TB-BC-04	<2.0	<1.9	<1.8	<1.4	<2.2	<2.1	<1.4	<1.3	<1.6	<2.0	ND
TB-BC-05	220	310	67	29	650	1200	100	4.8	36	2900	5517
TB-BC-06	2.6	<22	<20	<16	4.4	4.4	3.8	<15	<19	5.1	20
Screen level (SL)	1300	3200		670	1400	2600	1600	230	600	1700	12000
Mean	2.6	4.0		7.0	4.4	4.4	3.8	4.8	6.5	547	
Maximum	200	377		29	650	1400	110	4.8	600	3200	
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).											

Figure 1



SEDIMENT
SAMPLING & ANALYSIS PLAN
FOR THE
PORT OF GARIBALDI
TILLAMOOK BAY

August 1999

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1.0 PROJECT DESCRIPTION, SITE HISTORY AND ASSESSMENT

1.1 Project Site Description and Location: Tillamook Bay is located on the northern Oregon coast, approximately 75 miles west of Portland and 50 miles south of the mouth of the Columbia River. The Estuary is 3 miles wide and 6 miles long. It is supplied with freshwater by five rivers, draining an area of 533 square miles and is the third largest of the estuaries in the District.

1.2 Site History (authorized projects): The authorized project includes a channel 18 feet deep and 200 feet wide to a turning basin 18 feet deep and 500 feet wide in Miami Cove. These dimensions are not required by present usage so an approach channel, 12 feet deep, 100 feet wide and approximately 1,200 feet long, leads from deep water in the bay to the Garibaldi Boat Basin. From there an 8 foot deep, 75 feet wide and approximately 1,600 feet long channel, continues along the north edge of the turning basin to the Old Mill Marina. The Garibaldi Boat Basin access channel is maintained to 12 feet deep MLLW.

The channel in front of the Garibaldi Boat Basin, from river mile 3+00 to 3+26, is subjected to eddy currents from tidal action and the sediments transported downstream by the Miami River settle in the channel. Dredging of the inside channel is generally limited to this area. About 30,000 cy every 5 to 8 years will be dredged using a pipeline dredge, or clamshell and barge.

1.3 Previous Sediment Sampling: Sediment samples were collected in December 1980 for elutriate, chemical and physical analysis from Tillamook Bay entrance channel and the Garibaldi Boat Basin access channel. Water was collected and chemically analyzed for comparison with the navigation channel elutriates.

In May and July of 1985 sediment was collected from the Garibaldi Boat Basin access channel for physical and chemical analysis.

The most recent sampling event was March 22, 1990, when sediment samples were collected at 6 stations along the part of the channel fronting the Garibaldi Boat Basin. Three core samples collected near the entrance to the boat basin were taken using a gravity core sampler. The other 3 samples were surface grab samples taken with a Ponar sampler. All samples were submitted for physical analysis. Sediments outside the entrance to the boat basin were predominately sandy material with increasing amounts of gravel towards the mouth of the Miami River. Samples from the boat basin entrance channel were fine grained material (fines 50.3% to 71.5%) with volatile solids ranging from 7.3% to 11.6%. Material was similar to material collected in 1980 and 1985. The three core samples were, also, submitted for chemical analyses. The material represented by these samples was determined to be suitable for open in-water placement.

2.0 SAMPLING AND ANALYSIS OBJECTIVES

To characterize sediments in accordance with the Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River management Area manual.

Collect, handle and analyze representative sediment, surface and core samples of the proposed dredging prism in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.

Characterize sediments to be dredged for evaluation of environmental impact.

Conduct only physical and chemical characterization. If DMEF screening levels (SL) guidelines are exceeded, bioassays may be required for samples exceeding SLs, before sediment would be dredged.

3.0 SAMPLING AND ANALYSIS REQUIREMENTS

3.1 Project Ranking: The sediment area has not been ranked under DMEF guidelines, but based on data received from past sampling, the area outside the boat basin would be considered exclusionary. The samples representing material in the entrance channel to the Garibaldi boat basin would be considered “low”, as the data has not exceeded SL guidelines in the DMEF.

3.2 Sampling and Analysis Requirements: The guidelines for “low” contamination and of a homogeneous nature indicate one sample for every 100,000 cys of material dredged. If sediments were considered heterogeneous, one sample would be required for every 50,000 cy of material to be dredged. Three core samples and 3-grab sample are scheduled to be collected. These will be adequate sampling for the estimated 27,000 cys of material to be dredged.

4.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

4.1 Sampling Locations and Numbering: Figure 1 shows the project area and sample locations. Sampling sites are located for the best characterization of the material within the dredging prism as possible. Proper QA/QC procedures as outlined in this section will be followed. Any deviation from these procedures shall be noted in the field log. Sample identification shall follow the following convention:

TB-XX-YY

Where, “TB” denotes samples collected from Tillamook, “XX” denotes the type of sampling device such as “GC” = gravity corer, “BC” = Box Core grab; “YY” denotes the numeric sample sequence number and will consist of two digits for all samples, except composites (i.e. 01, 05, 15, etc.). A quality control (QC) replicate will not be collected for this sampling event. Composite samples (if collected) will have a combined number in the “YY” designation (i.e. sample 02 & 03 = 023, etc.).

4.2 Field Sampling Schedule: Sampling is planned for September 15, 1999.

4.3 Field Notes: Field notes will be maintained during sampling and compositing operations. Included in the field notes will be the following:

Names of the person(s) collecting and logging in the samples.

Weather conditions.

Depth of each station sampled as measured from the water surface. This will be accomplished using a leadline or corrected depth recorder.

Date and time of collection of each sediment sample.

The sample station number and individual designation numbers assigned for each individual sample.

Descriptions of sediment or core sections.

For cores the length of core and the penetration depth of the sampling device.

Any deviation from the approved sampling plan.

4.4 Positioning: Sampling locations will be recorded in the field. Horizontal coordinates will be referenced to the Oregon Coordinate System for proper North or South Zones NAD 83 (North American Datum 1983). Horizontal coordinates will be identified as latitude and longitude to the nearest 0.1 second.

4.5 Decontamination: All sampling devices and utensils will be thoroughly cleaned prior to use according to the following procedure:

Wash with brush and Alconox soap

Rinse with distilled water

Rinse with 10% nitric acid solution

Rinse with distilled water

Utensils used to collect physical samples only or sampling devices such as the power grab sampler will be washed down before each sampling event. However, they will not require the cleaning procedure listed above as long as samples collected for chemical analyses are not in contact with the core walls. All utensils used to collect chemical samples will require decontamination prior to each use. All hand work for chemical analyses will be conducted with disposable latex gloves which will be rinsed with distilled water before and after handling each individual sample, as appropriate, to prevent sample contamination. Gloves will be disposed of between samples or composites to prevent cross contamination between samples.

4.6 Core Logging: Each discrete core section will be inspected and described. For each core sample, the following data will be recorded on the core log:

Depth interval of each core section as measured from Columbia River Datum.

Sample recovery

Physical soil description in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, color)

Odor (e.g., hydrogen sulfide, petroleum products)

Visual stratification and lenses

Vegetation

Debris

Biological Activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)

Presence of oil sheen

Any other distinguishing characteristics or features

4.7 Field Compositing: Three core samples will be collected, chemical analyses will be run on each individual sample, with exception of organotin. All the core samples will be composited, prior to submission to the laboratory, for the organotin analysis. Cores to be composited may change in the field, based on sediment recovery and sediment similarity.

Numbering of the composites will contain the same designations of “site location” and “sampling device” as the other samples (as mentioned above, sec.4.1). Composite samples will have a combined number in the “YY” designation (i.e. sample 02 & 03 = 23, etc.).

4.8 Field Replicates: Blind field replicates will not be submitted along with the rest of the samples to the laboratory for this sampling event. Laboratory QC will be evaluated to access data quality.

4.9 Sample Transport and Chain-of-Custody Procedures: After sample containers have been filled they will be packed in ice or “blue ice” in coolers. Chain-of-custody procedures will commence in the field and will track delivery of the samples. Sample holding times and storage requirements are presented in Table 1. Specific procedures are as follows:

Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24 or delivered directly to the testing laboratory.

Individual sample containers will be packed to prevent breakage.

The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler and office name and address) to enable positive identification.

Chain-of-custody forms will be enclosed in a plastic bag and placed inside cooler.

Upon transfer of sample possession to the laboratory, the persons transferring custody of the coolers will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the coolers will be inspected and the receiver will record the condition of the samples.

Table 1, Sample Volume and Storage

Sample Type	Holding Time	Sample Size (a)	Temperature (b)	Container
Particle Size	6 Months	200 g	4°C	1-1 Quart Plastic Bag
PAHs, Phenols, Phthalates, Misc. Extractables, Chlorinated Organic Compounds	14 Days	125 g	4°C	1-1 Liter Glass (combined)
Total Volatile Solids	14 Days	125 g	4°C	
Total Organic Carbon	14 Days	125 g	4°C	
Mercury	28 Days	5g	4°C	
Metals (except Mercury)	6 Months	50 g	4°C	
Pesticides and PCBs	14 Days	10 g	4°C	
Organotin (pore water)	14 Days	4 liters(for extraction)	4°C	4-1 Liter Glass
Bioassays	14 Days	4 liters	4°C	

- Required sample sizes for one laboratory analysis. Actual volumes to be collected have been increased to provide a margin of error and allow for retest.
- During transport to the lab, samples will be stored on blue ice.
- A minimum 250-ml container is filled and frozen to run any or all of the analyses indicated.

5.0 LABORATORY PHYSICAL AND CHEMICAL SEDIMENT ANALYSIS

5.1 Laboratory Analyses Protocols. Laboratory testing procedures will be conducted in accordance with the DMEF. The samples will be analyzed for all the parameters listed in sections 5.1.3 and 5.1.4 as requested on the chain-of-custody record. Private contract analytical chemical laboratories will conduct all physical and chemical analyses.

5.1.1 Chain-of-Custody: A chain-of-custody record for each set of samples will be maintained throughout all sampling activities and will accompany samples and shipment to the laboratory. Information tracked by the chain-of-custody records in the laboratory include sample identification number, date and time of sample receipt, analytical parameters required, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

Limits of Detection: Detection limits of all chemicals of concern must be below screening levels. All reasonable means, including additional cleanup steps and method modifications, will be used to bring all limits-of-detection below the screening levels.

Sediment Chemistry: Private analytical laboratories will conduct all chemical analyses. Chemical analyses will include: metals (6010/7000 or 6020 series), total organic carbon (TOC) method 9060, polynuclear aromatic hydrocarbons (PAHs), phenols, phthalates, chlorinated organic compounds, misc. extractables by 8270 SIM method or other low level detection method, pesticides/PCBs by 8081 and Butyltin (TBT) compounds, by pore water method.

5.1.4 Sediment Conventions: The private analytical laboratories will analyze physical parameters. Particle grain size distribution for each sample will be determined. Sieve analysis will use a geological sieve series, which will include the sieve sizes U.S. NO. 5, 10, 18, 35, 60, 120, and 230. Hydrogen peroxide will not be used in preparations for grain-size analysis. Hydrometer analysis will use for particle sizes finer than the 230 mesh. Water content will be determined using ASTM D 2216. Sediment classification designation will be made in accordance with U.S. Soil Classification System, ASTM D 2487.

5.1.5 Holding Times: To the maximum extent practicable all chemical results will be provided within 7-14 days of receipt. All samples for physical and chemical testing will be maintained at the testing laboratory at the temperatures specified in Table 1 and analyzed within the holding times shown in the table.

5.1.6 Quality Assurance/Quality Control: The chemistry QA/QC procedures found in Table 2 will be followed.

5.2 Laboratory Written Report: The analytical laboratory documenting all the activities associated with sample analyses will prepare a written report. As a minimum, the following will be included in the report:

Results of the laboratory analyses and QA/QC results.
All protocols used during analyses.

Chain of custody procedures, including explanation of any deviation from those identified herein.
Any protocol deviations from the approved sampling plan.
Location and availability of data.
As appropriate, this sampling plan may be referenced in describing protocols.

Table 2, Minimum Laboratory QA/QC

Analytical Type	Method Blank ²	Duplicate ²	RM ^{2,4}	Matrix Spikes ²	Surrogates ⁷
Semivolatiles ¹	X	X ³	X ⁵	X	X
Pesticides/PCBs ¹	X	X ³	X ⁵	X	X
Metals	X	X	X ⁶	X	
Total Organic Carbon	X	X	X ⁶		
Total Solids		X			
Total Volatile Solids		X			
Particle Size		X			

1. Initial calibration required before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet criteria. Ongoing calibration required at the beginning of each work shift, every 10-12 samples or every 12 hours (whichever is more frequent), and at the end of each shift.
2. Frequency of Analysis = one per batch
3. Matrix spike duplicate will be run
4. Reference Material
5. Canadian standard SRM-1
6. NIST certified reference material 2704
7. Surrogate spikes will be included with every sample, including matrix-spiked samples, blanks and reference materials

6.0 BIOLOGICAL TESTING

6.1 Bioassays will not be run for this sampling event.

7.0 REPORTING

7.1 QA Report: The laboratory QA/QC reports will be incorporated by reference. This report will identify any laboratory activities that deviated from the approved protocols and will make a statement regarding the overall validity of the data collected.

7.2 Sediment Evaluation Report: A written discussion of findings shall be prepared documenting the physical, chemical and biological (if necessary) character of potential material to be dredged. The physical and chemical reports will be included as reference; individual copies will be furnished as requested. As a minimum, the following will be included in the

Previous sampling and analyses.

Locations where the sediment samples were collected.

A plan view of the project showing the actual sampling location.

Description of sampling.

Chemical testing data, with comparisons to screening levels guidelines.

Biological testing data and evaluation based on the DMEF manual.

APPENDIX A

PARAMETERS AND METHODS

1. Recommended Sample Preparation Methods, Cleanup Methods, Analytical Methods and Detection Limits for Sediment Management Standards, Chapter 173-204 WAC, Draft - July 1996.
2. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program, March 1986.
3. Recommended Methods for Measuring TOC in Sediments, Kathryn Bragdon-Cook, Clarification Paper, Puget Sound Dredged Disposal Analysis Annual Review, May, 1993.
4. Units: ug = microgram, mg = milligram, kg = kilogram, dw = dry weight, oc = organic carbon.
5. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 3050, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.2, Rev 1. Office of Solid Waste and Emergency Response, Washington, DC.
6. Graphite Furnace Atomic Absorption (GFAA) Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
7. Inductively Coupled Plasma (ICP) Emission Spectrometry - SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
8. Test Methods for Evaluating Solid Waste. Laboratory manual physical/chemical methods. Method 7471, SW-846, 3rd ed., Vol. 1A, Chapter 3, Sec 3.3. Office of Solid Waste and Emergency Response, Washington, DC.
9. Sonication Extraction of Sample Solids - Method 3550 (Modified), SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986. Method is modified to add matrix spikes before the dehydration step rather than after the dehydration step.
10. GCMS Capillary Column - Method 8270, SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.
11. Purge and Trap Extraction and GCMS Analysis - Method 8260, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

12. Soxhlet Extraction and Method 8081, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, EPA 1986.

13. Total PCBs BT value in mg/kg oc.

QA2 DATA REQUIREMENTS

CHEMICAL VARIABLES

ORGANIC COMPOUNDS

The following documentation is needed for organic compounds:

A cover letter referencing or describing the procedure used and discussing any analytical problems

Reconstructed ion chromatograms for GC/MS analyses for each sample

Mass spectra of detected target compounds (GC/MS) for each sample and associated library spectra

GC/ECD and/or GC/flame ionization detection chromatograms for each sample

Raw data quantification reports for each sample

A calibration data summary reporting calibration range used [and decafluorotriphenylphosphine (DFTPP) and bromofluorobenzene (BFB) spectra and quantification report for GC/MS analyses]

Final dilution volumes, sample size, wet-to-dry ratios, and instrument detection limit

Analyte concentrations with reporting units identified (to two significant figures unless otherwise justified)

Quantification of all analytes in method blanks (ng/sample)

Method blanks associated with each sample

Recovery assessments and a replicate sample summary (laboratories should report all surrogate spike recovery data for each sample; a statement of the range of recoveries should be included in reports using these data)

Data qualification codes and their definitions.

METALS

For metals, the data report package for analyses of each sample should include the following:

Tabulated results in units as specified for each matrix in the analytical protocols, validated and signed in original by the laboratory manager

Any data qualifications and explanation for any variance from the analytical protocols

Results for all of the QA/QC checks initiated by the laboratory

Tabulation of instrument and method detection limits.

All contract laboratories are required to submit metals results that are supported by sufficient backup data and quality assurance results to enable independent QA reviewers to conclusively determine the quality of the data. The laboratories should be able to supply legible photocopies of original data sheets with sufficient information to unequivocally identify:

Calibration results

Calibration and preparation blanks

Samples and dilutions

Duplicates and spikes

Any anomalies in instrument performance or unusual instrumental adjustments.

Figure 1, Proposed-sampling locations for September 15, 1999 sampling event.

